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Theorizing the IT Artifact for Mobility: A Portfolio, Not a Singularity

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THEORIZING THE IT ARTIFACT FOR MOBILITY: A PORTFOLIO, NOT A SINGULARITY

La Théorisation de l'Artefact Informatique pour la Mobilité : un Portefeuille, pas une solution singulière

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Abstract

The IS literature is focused on the 'IT artifact' as a singular technology. Changing patterns of technology use indicate the need to re-examine this focus. This paper investigates the nature of technology selected and used by people on the move through field studies of three user cohorts. The findings show that people choose from myriad technologies to construct personal portfolios of technology that are then accessed when mobile. These actions are understood by applying Emirbayer and Mische's temporal dimensions of human agency that depict people juggling orientations to the past and the future while dealing with the present. This multiplicity of technologies accessed when mobile has profound implications for how we theorize and research the 'IT artifact'. The findings challenge us to reconsider existing IS models and research strategies and open new avenues of research to examine how people select, combine and apply multiple technologies over time.

Keywords: Mobility, IT artifact, technology portfolio, human agency, temporal orientations

Résumé

La littérature en SI traite de l'artefact informatique comme d'une technologie unique. La présente communication scrute, à travers des études sur terrain de trois groupes d'utilisateurs, la technologie employée par des personnes en déplacement. Les résultats démontrent que celles-ci sélectionnent, regroupent, et mettent en oeuvre diverses technologies pour confectionner des portefeuilles technologiques. On comprend ces actions à la lumière des notions d'Emirbayer et Mische sur les dimensions temporelles de la 'human agency'. Cette communication présente les implications de ces données en ce qui concerne la théorisation de l'artefact informatique, les modèles actuels de SI et nos stratégies en matière de recherches.

Introduction

"*My bag, it's got all my laptop stuff and it's got the PDA, all those things. Diaries, appointments, new USB port, digital camera, cell phone, laptop, all these mobile devices and I chuck them all in my bag*". (Female participant)

In 2001, Orlikowski and Iacono published a sobering analysis of the role of technology in articles published in one of the top information systems (IS) journals. They found that, in the majority of articles, technology was absent, a proxy or simply conceptualized as a tool and that richer conceptions of technology were present in only 12.5% of the papers. The authors posed a challenge for IS researchers to 'theorize the IT artifact'. This paper addresses Orlikowski and Iacono's challenge and theorizes about technology that is selected, accessed and used by people on the move. Mobility has been one of the most influential technological trends of the twenty-first century. Further, it is an indicator for the future: the central role of young people—the pathfinders in mobility as well as the group with unsurpassed facility with computer-based technologies—provides us with insight into the nature of future IS practice. This is an area of great interest and significance for IS researchers.

Technology innovations occasionally have profound influences on our practices. This then causes us to re-think the concepts and theories that we apply to the interaction between people and technologies: such innovations act as a catalyst for changes in users' practices as well as our theorizing. The growing complexity and sophistication of groupware, for example, triggered adaptation of structuration theory for the discipline of IS (De Sanctis and Poole 1994; Orlikowski 1992). During the previous decade, various technologies have become available for people on the move. The outcomes of people's uses of these technologies have led to re-conceptualization of key IS concepts. The context of technology use is no longer confined to a single-site organization but now includes social, personal, entertainment, educational and leisure contexts as well as organizational work away from the desk or office. The importance of communication in use of these technologies led to a change in name from Information Technology (IT) to Information and Communication Technology (ICT), thus potentially broadening the brief of IS. An area in need of re-conceptualization that has been neglected to date is that of the 'technology' itself, as part of the wider debate about the nature and role of the IT artifact. Here, 'technology' includes material artifacts such as computer-based devices, hardware, software applications and digital media. This paper builds on findings from three field studies and argues that mobility entails a shift from using single artifacts to dynamically constructing, enhancing and accessing portfolios of technology. The question addressed by the paper is: "What is the nature of technology that people access while mobile, and how is that technology selected and used?"

Examining people's actions in selecting and using technologies raises the issue of human agency. Human agency has been used to explain diverse outcomes from the installation of the same technology (Barley 1986; Orlikowski 1992). It acknowledges the importance of human choice, will and preferences that are exercised subject to the constraints of organizational and social structures as well as the material constraints of a technological artifact (De Sanctis and Poole 1994; Orlikowski 1992). The approach taken to addressing the research question draws on the temporal dimensions of human agency proposed by Emirbayer and Mische (1998). This perspective is applied to explain individuals' technology choices in terms of dealing with conflicting orientations to the past (what has been learned, used or experienced previously) and the future (that offers uncertain possibilities) while navigating the contingencies of the present.

The paper begins by outlining existing IS work on selection of technology artifacts at the organizational and individual level. The domain of interest, mobility, is introduced and then aspects of Emirbayer and Mische's theorizing of the temporal dimensions of human agency are presented. This is followed by a description of the research method, the three field studies and the findings. The discussion section analyzes the findings in relation to the temporal dimensions of agency. It describes the way that, as the participants move from place to place, they exploit familiar technologies in their portfolios while expressing hopes, desires and fears for the outcomes of future technology innovations. At the same time, they deal with the uncertainties of the present by drawing upon the resources in their technology portfolios. Three major implications of the findings are drawn out, the consequences of: technology portfolios for the concept of the IT artifact; observed user practices while mobile for IS models and frameworks; and the rich accounts of mobility derived from the 'swamp' of real-world practices for IS research strategies. The paper concludes that, while the catalyst for re-conceptualizing the IT artifact is mobility, the trend toward thoughtful, multiple-technology use is not confined to people on the move, indicating that this is a fertile area for further exploration.

Background

Selection of Artifacts

Orlikowski and Iacono (2001) analyze the nature of the IT artifact in papers published over a ten year period in the Information Systems Research journal. They observe that much IS research conceives of IT artifacts as objects that are "relatively stable, discrete, independent, and fixed"' and contrast this with an alternative conceptions of technology as ensembles composed of "equipment, techniques, applications and people" whose outcomes emerge in unexpected ways (Kling and Scacchi 1982). Throughout their analysis, the IT artifact is almost exclusively described in singular terms ('a tool', 'a computing resource', 'an artifact' as well as specific instances of IS such as 'a geographical information system'). This emphasis on a singular IT artifact is not unusual: examination of empirical studies of technology selection and/or use found few studies where the unit of analysis was not a single technology, device, application or system. Ongoing selections and uses from a range of available technologies have been comparatively neglected in IS research.

Extensive research has been undertaken at the organization level into the selection and implementation of complex enterprise systems or configurational technology that "is built up from a range of components to meet the very specific requirements of the particular user organization" (Fleck 1994:637). These systems interact with other organizational systems and evolve as the organization changes (Lee and Myers 2004). Ciborra and his associates studied the ways that large-scale information infrastructures took shape over extended periods of time (Ciborra and Hanseth 2000). These complex enterprise systems are the outcome of a series of choices of systems, components and practices on the path towards constructing a stable configuration. The result is an ensemble that, once constructed, may not be deconstructed: the choices that led to its particular shape may be impossible to roll back.

There has been some work on the effects of existing technologies when introducing a new technology. Chae and Poole (2005) explore the influence of pre-existing systems on the implementation of a new IS and note the lack of research in this area. Rogers (1995) argues that technology clusters, or other closely-related technologies that are used prior to the introduction of an innovation, can influence the rate of adoption of new innovations. Existing technologies may be competing, in which case the innovation may provide relative advantage and displace them, or complementary, where synergistic effects may lead to increased levels of use of all technologies in the cluster (Shih and Venkatesh 2004). Rogers (1995:15) argues that treating innovations in a cluster separately "is a distortion of reality" as an individual's experiences with one technology "influences perceptions of the next innovation to diffuse through the individual's system." One of the few papers that examines users' choices where there are multiple devices is Shih and Venkatesh (2004), who apply the concept of complementary technologies in their study of a multi-use consumer device (the computer) in domestic contexts; however, they only study the number of complementary technologies and their perceived impact on the variety of uses of the computer.

Research in media selection for communication investigates choices made by individual users from a range of alternatives. The roles of media richness, presence, synchronicity and social influences have been studied in the selections between various media such as face-to-face, telephone, paper and email (Dimmick et al. 2000; Webster and Trevino 1995). However, contemporary works in the area "implicitly focus on the selection and use of only one medium at a time" and so overlook the simultaneous use of multiple media (Massey and Montoya-Weiss 2006:100). Recent work by Dennis et al. (2008) indicates that communication is enhanced through a combination of media, either simultaneous or sequential, thus signaling the importance of this research perspective.

Mobility

The possibilities of seamless and invisible technological support for people on the move led to early visions of pervasive and ubiquitous computing (Kleinrock 2001; Lyytinen and Yoo 2002b; Weiser 1991). In contrast, mobility or nomadic computing involves support for people as they move from place to place, where technology is accessible but not necessarily embedded within the environment (Yoo and Lyytinen 2005). Mobility may involve wandering within the one location, transiting between locations or traveling longer distances (Dahlbom and Ljungberg 1998). Services are provided through multiple devices and are available "whenever and wherever they are needed" (Lyytinen and Yoo 2002a). This access to computer-based resources 'anytime, anywhere' is the key to mobility (Perry et al. 2001). People on the move may draw upon technologies that are carried or attached to their bodies (such as mobile phones, laptops and BlackBerries) as well as those that are accessible as they move (such as 'hot spots'

provided in networked environments, desktop computers at a hot desk or an internet café, and an organizational intranet that allows remote access). Thus, mobility encompasses access to technology that is:

- mobile, or capable of being mobile (mobile technology), and
- stationary or fixed and available to people on the move.

Diversity of accessible technologies is integral to mobility and leads to research challenges relating to adoption and use of multiple interaction channels (Lyytinen and Yoo 2002a) that have received little attention. Most studies of mobility focus on the use of one technology such as the mobile phone (Carroll et al. 2002, 2003; Katz and Aakhus 2002), PDA (Golden and Geisler 2007) or mobile email (Middleton and Cukier 2006) or use in a particular context (Henfridsson and Lindgren 2005). Other studies feature multiple technologies, where several cases involving use of a single technology are combined (examples are Ferneley and Light 2006; Sawyer and Tapia 2006). The social implications of mobile technologies include the mobile phone as a sign of peer-group membership (Carroll et al. 2002), personal control (Golden and Geisler 2007) or reciprocal gift-giving (Taylor and Harper 2002). Other studies have noted the addictive nature of the Blackberry (Middleton and Cukier 2006) and consequent work/life boundary issues (Golden and Geisler 2007). In contrast, there is a small number of use-centric studies. Rather than examine a particular technology, these projects focus on the individual user on the move and analyze the technologies that are applied for various activities (Sorensen and Pica 2005), contingencies (Perry et al. 2001) and managing the boundaries between business and personal activities (Cousins and Robey 2005). These studies provide insights into the complicated nature of selections and uses of multiple technologies by people as they move from place to place. This is a complex situation involving human preferences, many possible paths of action and unpredictable effects. It involves the exercise of human agency.

Temporal Dimensions of Human Agency

Human agency has been an important theoretical perspective used to explain diverse, unexpected and inconsistent outcomes from the use of technologies over time (Barley 1986; Boudreau and Robey 2005; De Sanctis and Poole 1994; Howard-Grenville 2005; Orlikowski 1992). Human agency encompasses the motivation, orientation, choice and actions that are associated with the volitional rather than the determined aspects of human nature (Emirbayer and Mische 1998; Jary and Jary 1991). Theories of human agency applied in IS research include structuration theory (Giddens 1984), the mangle of practice (Pickering 1995) and the temporal dimensions of human agency (Emirbayer and Mische 1998).

Emirbayer and Mische (1998) aim to capture the complexity of agency and the interplay between its elements in order to overcome shortcomings of existing theorizations such as Giddens's privileging of routine practices. They argue that human agency is "a temporally embedded process of social engagement" that is simultaneously informed by the past and looks to the future as well as dealing with the present. Thus, human agency can only be understood by examining its situation within the flow of time. Diverse outcomes from technology use can be explained by individual users' responses to conflicting temporal orientations.

This temporal emphasis is valuable for studying mobility, that challenges conventional notions of time and space (Kakihara and Sorensen 2002). It also provides an individual perspective that extends work on time horizons at the organizational level. Brown and Eisenhardt (1998) argue that, in times of rapid change and high uncertainty, organizational strategy should balance 'on the edge of time' and simultaneously harness past experiences, look ahead to the future while focusing on current execution. This is similar to the tradeoff between exploring future possibilities while exploiting current knowledge in effective organizational learning (March 1991). Such a strategy avoids excessive dependence of past experiences and competitive models or overemphasis on the possibilities of the future: "systems evolve most effectively by gradually shedding what was useful in the past and adopting what will be most useful in the future" (Brown and Eisenhardt 1998:14).

The temporal dimensions outlined by Emirbayer and Mische are:

- Iterational, looking to the past with its habitual elements including past practices, meanings and experiences. It refers to "the selective reactivation by actors of past patterns of thought and action, as routinely incorporated in practical activity, thereby giving stability and order… and helping to sustain identities, interactions and institutions over time" (Emirbayer and Mische 1998:971),

- Projective, looking to the future as a capacity to imagine alternative possibilities or as a space for creative thinking. Projectivity "encompasses the imaginative generation by actors of possible future trajectories of action, in which received structures of thought and action may be creatively reconfigured in relation to actors' hopes, fears, and desires for the future." (Emirbayer and Mische 1998:971), and
- Practical-evaluative, looking to the present as a capacity to contextualize past habits and future projects "within the contingencies of the moment" (Emirbayer and Mische 1998:963). Human agents may have different but simultaneous temporal orientations as they deal with multiple unfolding situations; they may switch between orientations in response to emerging issues or they may maintain a primary orientation over time in a situation. The choice of orientation in any situation is made in the face of incomplete information and ambiguity. Practical evaluation entails "the capacity of actors to make practical and normative judgments among alternative possible trajectories of action, in response to the emerging demands, dilemmas, and ambiguities of presently evolving situations." (Emirbayer and Mische 1998:971).

These are analytical distinctions: all three dimensions are found, in varying degrees, in any human action.

A particular strength of Emirbayer and Mische's perspective is that, through the future orientation, it emphasizes the possibilities for change, creativity and innovation by humans. This serves as a counter-balance to the routines, habits and stabilization that have been much explored in IS research (Howard-Grenville 2005; Orlikowski 1992). Humans are immersed in multiple contexts with different, simultaneous temporal orientations (Emirbayer and Mische 1998:967). Their perspective explains how, through a switch in temporal orientation, things can be being otherwise, even though the constraints of habit may be difficult to shift. This makes it particularly suited to IS studies where change and uncertainty are prominent; IS research that applies Emirbayer and Mische's perspective includes Boudreau and Robey (2005), Chu and Robey (2008), Cousins and Robey (2005) and Howard-Grenville (2005).

Research Method

This research examines the technologies associated with mobility, encompassing the resources that individual users select, access and apply in order to provide practical and/or symbolic value. This necessitates a fine-grained analysis where the notion of a technology is seen not as a completed technology with given purposes of use and functions but rather as decomposed into its components, as "sets of loosely bundled capabilities [that] can be implemented in many different ways" (Gutek et al. 1984). Thus, a technology is seen as comprised of a device or system, applications and media. In use, these components are explored and interpreted: some may be rejected while others are adopted, adapted and applied in many different ways (Carroll et al. 2003; DeSanctis and Poole 1994).

Intensive studies of small numbers of participants were chosen to provide depth of understanding, in line with Lyytinen and Yoo's (2002a) call for 'up close' field studies of mobility as it unfolds. A purposive sampling strategy was adopted to observe the phenomenon of interest (Miles and Huberman 1994). This strategy aimed to provide data for developing an empirically grounded argument about people's technology selections and use while mobile (Mason 2002). Multiple cohorts were studied to decrease the likelihood of premature theorization based on the practices of one cohort (Glaser and Strauss 1967). Criteria for choosing cohorts were expertise with mobile technologies and mobility in everyday activities. Three cohorts were studied. Two cohorts, IS/IT postgraduate students and young professionals, were aged between 20 and 35 and so are likely indicators of future trends (Carroll et al. 2002; Ling and Yttri 1999). The third cohort, IT consultants, was selected because of their expertise in applying state-of-the-art technologies.

The research design was guided by the suggestions of Spradley (1979:8) that learning about others rests with examining what people say and do, and the artifacts they use. Access to both what users say they do and what they are observed to do provides understanding of their practices; participants' perceptions and use of various mobile and fixed artifacts as well as non-electronic resources were examined. Both contextual (studying participants in their everyday contexts of technology use) and a-contextual (out of context, where participants can provide greater attention to research issues) methods were employed. Thus participants were observed at their everyday activities, immersed in the people, activities, sounds and needs that drive their interactions with technology. They were also interviewed so that they could concentrate on addressing specific research issues away from these contextual distractions. The research process involved an initial session where participants individually completed a questionnaire to gather data about their circumstances, technology ownership, preferences and forms of interactions with others. They then participated in a focus group that was run by an experienced facilitator using a line of questioning constructed by the author. The author observed and participated as joint facilitator to explore emergent

themes and probe key issues in greater depth. At the end of the focus group, arrangements were made for follow-up semi-structured interviews and observations at locations of the participants' choice. These were undertaken by the author and research assistants under her supervision. The interviews and observations were guided by a list of broad issues but open to investigate unexpected actions and responses, as is advisable with exploratory research. The final session involved a further questionnaire and focus group. This process was adjusted for the IT consultants. Given time pressures and their mobile working style, it was not feasible to bring them together for focus groups. Instead individual semi-structured interviews and observations on the move at work (individually and in pairs) were undertaken.

The data, comprising audio- and video-tapes and interview and field notes, were transcribed then analyzed by the author, informed by the principles of Miles and Huberman (1994). The initial analysis of each cohort was guided by the key research concepts but open to emergent concepts. Descriptive codes were identified and refined through iteratively re-reading the transcripts; the final codes were activity, purpose, available resources (device, application, media, non-electronic), preferences, control and practices (past, present and future). Case narratives for each cohort were constructed. Next, cross-case analysis revealed similarities and differences between the cohorts. Common patterns of technology selections were identified using inferential codes that reflect the influences on the cohorts' technology selections and uses. Emirbayer and Miche's perspective on human agency was chosen to theorize the inferential coding. Three major categories related to the temporal dimensions of participants' technology selections while mobile were inferred. The metaphor of a technology portfolio was applied to express habit or past experiences; contingencies capture the uncertainties of the present; and imaginings represent perceived future possibilities, both positive and negative. These were brought together into a framework to express the influence of temporal dimensions on mobility. Extracts from the case narratives for each cohort are presented in the Current Practices section. The framework of the temporal dimensions of users' technology selections while mobile is pictured and described in the Discussion section.

Current Practices

Postgraduates

All Honours students in two IS/IT departments at two universities were invited to participate in the research. Seven female and four male students agreed; all except one student were in their twenties. The postgraduates use technology for work-related, educational, social and personal activities. The primary purpose of technology use was communicating with secondary purposes including managing information (gathering, storing and accessing), organizing their lives, providing affect (pleasure, entertainment) and expressing identity (style, image, sociability). All participants accessed a range of technologies. These included devices such as the mobile phone, laptop, PDA, personal computer (PC), camera, MP3 player and USB drive; applications including SMS (text messaging), email, chat (ICQ, MSN), scheduler, address, clock, alarm, games; digital media were voice, text, image, audio; and other non computer-based resources included diary, notes, pen and paper and face-to-face media.

For most of the participants, the mobile phone was usually selected in situations where participants could only carry limited resources: "My phone is just really convenient". The favorite technology of nine participants was the mobile phone; two participants owned a PDA and nominated it as their favorite. The value of PDAs rests on providing access to all important information at any time and any place but they used their mobile phones for communication.

Technology is used to organize participants' lives: "My phone has all my numbers in it." A participant described how he was very disorganized until his parents gave him a PDA: "since then my life's just turned around. It just became so easy…because all of a sudden I'm always on time, I never forget things… I'm just so organized". The PDA contains his calendar, address book, list of greatest movies ever, funny quotes: "it doesn't matter, it's all there. It doesn't change.. it's always 2 inches by 3 inches by half an inch, no matter how much I put on it, it's never going to get bigger." Stored information has an affective role: the second PDA owner stores pictures of her pet rabbit on it and she uses it to take photos to share with friends. Her PDA "has a name… this is my friend." It contains all her essential information, "If it's in your Palm, you've got everything in there." Other participants keep special SMS messages on their phones and review them from time to time. Some play games: "I like playing the games when I'm bored. Games are really important." Mobile phones also express owners' identities: one male participant "has lots of numbers, this shows I am a sociable person' while another is sociable "cos I send lots of SMSs."

The participants were discriminating users who displayed a fine-grained appreciation of the strengths and weaknesses of available technology. A female participant uses her PDA and a desktop PC: "they synch nicely", the PDA has a keyboard so she uses it as a laptop when mobile. Participants used the iPod, originally a music player, for other activities. One participant uses her iPod to store PowerPoint presentations: "you can use it like a USB key, so I've got a presentation that I'm doing this afternoon on PowerPoint, I'll just transfer it across to the computer and run it tonight cos it's 20 G worth of space, it's a lot more useful than a USB key…" Later she was observed using a USB key to store word processed files and noted the convenience and lower cost of a USB key that can be kept in a pocket. However the use of diverse devices for similar tasks led to management issues such as version control (files are on the iPod, USB key and attached to email messages).

Participants expressed clear preferences for matching media (voice, text, image and audio) and applications (email, SMS, voice call) to a particular activity. An international student emails her boyfriend every day but she views emails as "not personal. Well they are personal but when you talk there's so many interactions that you can say and do, you're just restricted to typing in an email… You can't keep a relationship alive over email, you've got to talk on the phone." Further, within the one medium (text), alternative applications (SMS, chat and email) provided for nuanced communication. An example related to making and maintaining friendships. Although voice was preferred, it was viewed as acceptable to email or chat with people that you have not met face to face. However there was broad agreement that you should not SMS someone that you have not yet met or created a relationship with. This is summed up by a male participant: "With new people I prefer to use a voice call than SMS. It's a bit more personal and it's too unsighted: SMS. So if they don't really know you and you just SMS them, it's not really going to help. You need to actually have a conversation. And it's better in person than down the phone." A female added: "I think phones to me are more about maintaining friendships whereas you can use the Internet to make them… I use email, ICQ or MSN to make friends and SMS to maintain it". Another female said: "I'm very old fashioned. I don't use SMS, I have to meet somebody and talk to them. Using technology to meet somebody makes no sense to me at all".

Retaining control over technology is important. Several participants noted negative aspects of the wealth of available technologies: "If you have too much technology in your life, you get reliant on it. I think all of them, a nightmare…Just try to keep to one device." A male Mac user dislikes convergence: "I really hate that. I want my email program to be email. I don't want it talking to MS Word: that's a word processor, that's something different" He wants control of any interactions between programs rather than occurring automatically. Some participants were interested in device convergence although the physical constraints were acknowledged: the mobile has a really tiny screen so "maybe you can't consolidate all of the laptop's functionalities."

At times, technologies are discarded for other resources. There was agreement amongst the female participants that private information or gossip is chiefly communicated face to face: "Email leaves a trace: it's a bit too concrete". In addition, being present physically allows you to gauge the receiver's reactions "and you can be there also to do damage control" in case your comments are misunderstood. Also, not all participants use technologies for scheduling or recording their activities. One male participant keeps appointments in his head (he was late for the initial focus group). Others prefer paper diaries. A paper diary is more reliable (it doesn't have batteries) but the prime attraction is that it is more personal, decorated in a unique way. A female participant believed that it is more suited to her preferences: "And I very much like the pen and the paper aspect… I just prefer it that way."

IT Consultants

A multinational IT company provided access to its consultants who travel frequently to meetings with clients and colleagues within the one large city (population of almost 4 million people) and between states in Australia. Seven staff members (six male and one female) agreed to participate. The IT consultants used technology for work, social and personal activities while on the move. The technologies accessed included such devices as mobile phone, laptop, PDA, IPAQ, MP3 player, digital recorder and hands-free kit for the car; applications including addresses, calendar and task lists (schedule), SMS. MSWord, Project and Excel, email (a company standard), PDF Writer, Internet browsers, specialized prototyping tools (Visio, PowerPoint); digital media were voice, text, image, audio; and other non computer-based resources such as exercise books, pen and paper and face-to-face media. The inter-relationship between purposes of use is captured by one participant who said that "more often than not, last minute issues arise in the hour before a meeting" so she needs to *contact* colleagues and try to *gather information* about the issue, she then *communicates* with other members of the team who are attending the meeting.

The mobile phone is the primary resource for these participants because "the convenience of the phone is too good." The participants access a wide range of devices and applications for multiple purposes. One consultant draws upon an IPAQ (that he synchronizes with his work PC) and its applications including the calendar, address book and task list, mobile phone (used for coordinating between his team and clients) and a hands-free kit in his car. He also carries a laptop in a shoulder bag along with its various attachments. A second consultant carries a laptop (used at client sites for presentations), a very old and heavy mobile device ("it was state of the art last century") with addresses and some tasks and an old Nokia mobile phone that is kept in a leather case clipped to his pocket (he has a history of losing phones). He doesn't synchronize these because it is "too hard, too slow".

For these consultants, time is "absolutely critical… it shows due respect." Their professional image is crucial and so they manage their time carefully. One said that, if he is running late for an appointment, he can save face by ringing ahead on his mobile but dislikes doing this. After meetings he will find a quiet place and enter detailed notes into his laptop. Another uses his resources whenever he is between meetings to minimize waste time (for example, he calls someone, works on his laptop or spends time organizing). He can coordinate with others or backup if someone is running late. A senior manager is focused on the short term: "I'll just prepare for this meeting" and so he reviews proposals to be discussed. He makes calls or uses his PDA for email in dead time. He accesses his mobile using a hands-free kit in the car between meetings and may coordinate with the rest of his team for a meeting.

These participants had greater focus on the technology itself, not surprising given their employment in an IT company. The shortcomings of existing technologies were clearly articulated: "I have an IPAQ, I find it quite difficult to type, I don't like typing in for too long" and "The IPAQ is just too small, you're always scrolling." Accordingly, one participant writes information about each client in a separate exercise book; these exercise books are carried to meetings. The notes are not transcribed so she cannot access the notes electronically. Also, some applications require a larger screen: "Again, this is why you need the bigger device. If you're looking at a map with public transport, roads and so on, you need to have a big enough area to see the context of that information." The participant expressed a desire for a converged device that was "not as big as a laptop but larger than a PDA."

Sensitivity to the affordances and constraints of devices, applications, media and between electronic and paper-based resources was apparent. One participant travels to meet clients to demonstrate technologies and needs "the correct device and information for the task." He uses a small laptop at work and home and a PC at home. He uses a mobile phone for voice and a Palm for email, notes and calendar: he "flip flops from each other". He synchronizes the Palm and laptop but not the Palm and mobile phone. When he travels interstate he takes the Palm not a laptop – he uses the Palm as a reference but not for writing (this is for the laptop).

Fewer nuances of media selection were noted than in the postgraduates. Voice was preferred for coordination of both colleagues and clients. When privacy is an issue, text rather than voice is used. SMS and chat are viewed as suitable for colleagues but not clients; email should be used for clients. In public places: "You don't know who's sitting beside you, it may be another client or competitor. I'm far more comfortable writing to someone, typing it in." In the car a participant will use an earpiece and mobile phone to talk to clients but she does not have access to information on the fly, and she must find a way to write down questions while driving. Finally, the issue of control was important: information overload is common and the participants expressed dissatisfaction with having information or advertising pushed onto devices: "I'd prefer to be able to search for stuff that's around me and me connect to it rather than it being automatic and sensing stuff. I want to limit the information coming in… I get too much information coming in as it is. "

Young Professionals

Eleven young professionals were recruited by a professional recruitment agency on the basis of owning up-to-date mobile technology such as a BlackBerry or internet-enabled mobile phone. There were six females and five males. Participants' professions included events manager, business analyst, project manager, ship's captain, architect, graphic artist and IT worker. They use technology as an integral part of their everyday lives. Participants spoke of their dependence on mobile technology: "You'd be lost without it" and "I take it to be with me, it's on the bedside table. I turn it off at night now. I turn it off when I go to sleep and turn it on first thing in the morning." Another said: "I walk around, if it's not in my pocket, straight away, something's not right, I'm missing something." For most participants, mobile phones are with them and turned on "24X7. It's only off if the battery is dead."

The technologies accessed by the young professionals included devices such as mobile phone, desktop PC, laptop, USB drive, MP3 player (iPod, iRiver), BlackBerry, digital camera, PDA, Nokia (with a torch), portable hard drive;

applications including email (work and personal accounts), Lotus Notes, Outlook, diary, SMS, voice, voicemail, SMS alerts for voicemail and email, MMS (picture messaging), games, clock, alarm, scheduler, web browser for mobile, digital organizer and AutoCAD; digital media were voice, text, image, audio; and other non computer-based resources such as paper diary and business cards and face-to-face media. Each participant accesses a range of technologies. One participant has: "a desktop at home and desktop at work, and a portable hard drive. My phone has a camera but I don't use it, I use a digital camera for work." A second participant uses his mobile phone for: "Voice, organizer (because it is linked to Outlook on my computer), then a clock, incorporating an alarm clock, and I play checkers. And SMS. I get a lot of email through my phone, so a phone, it almost completes you in a way." A third participant uses an iRiver (MP3 player), PC and mobile. Another participant has two mobile phones on different carriers with different plans: "When I'm on one phone I can see who's ringing on the other."

The primary purposes of technology use for this cohort are slightly different to the postgraduates and the IT consultants. For this user cohort it was contact that subsumes communication. One participant said: "I think people really value contact with each other, speaking and communicating. I guess the issue of just communicating over-rides all commonsense, if someone's communicating with you, you want to see who it is, you don't worry about the fact you're driving." Participants noted that they are contactable 24X7 "no excuses", they are now contactable at more times such as by work during personal hours and the generic "where are you?" is an issue for their privacy. Although phones can be turned off, this is not generally practiced.

Technologies are used for organizing personal and work life. Many used the organizer on a mobile phone. One favors this because it is linked to Outlook on her computer, she also uses it as a clock, incorporating an alarm clock. "I'm hopeless with a diary, I've got alarms on it to remind me where I'm supposed to be, I synchronize it back with my diary on the computer. I need three alarms to get me up (at 5.30am) in the morning." Others use the phone to organize their personal lives: "the calendar function, for appointments and meetings but not really work-related, just anniversaries and birthdays." The mobile helps to manage participants' time while on the move: "I can answer queries when out on site." For some participants, the mobile phone has replaced a watch as their primary timepiece: "I got rid of my watch last year." Another said: "I have a watch as well but usually I go by my phone. The phone is on all night, and the alarm function wakes me up. And it's my alarm. Calendar, I use it for meetings and birthdays. Sometimes my friends use my phone, they want to get a phone number for something, so we look up Yellow Pages [directory]. It's for convenience mainly."

Some participants described how they carefully separated their work from personal lives: "You'd never send a job application from your work email address" and "I keep all my work stuff on Lotus Notes at work, keep it separate because I like to keep my phone separate." A number do not share their mobile number with work: one said she would tell people her mobile number if she trusts them and similarly does not provide her work email to friends – "it keeps your personal life away from the organization." This was supported: "When I'm not at work other people deal with the problems. I feel that my personal time is my time." Another has her work phone number but not her mobile number on her business cards because "it is personal, it's not even on the work database". A fourth participant said: "I don't give out my mobile number at work… I do appreciate the quality time I spend with my family." In contrast, other participants use technology to seamlessly link these two spheres of their lives. One gives everyone his mobile number and his mobile is always on; he does not have voicemail because "I have no time to check for messages." A female manager said: "So basically I use my PDA and phone and link to the office and from that I can do anything I need." This participant has a desktop PC at home and synchronizes the diary on her phone. Her social and work-related events are mixed in with each other: she is managing her life, not her work or private issues.

Time is an issue, but in a different way to the IT consultants. Time is scarce for these young professionals, so scarce that some choose not to have voicemail: if they are too busy to answer the mobile then the caller will have to ring again. They do not have time to check and respond to voicemail messages. A participant described her strategy: she gets a lot of email, "email, people email me 'cos I get too many calls, I tell them not to ring, I tell them to email me. If you send me a message I can actually be on the phone and address an issue at the same time." In addition, she has a hotmail account and she is notified on her mobile if she receives an email to this account. Another participant receives SMS alerts "when I've got voicemail on my work phone."

Like the post-graduates, the young professionals expressed clear preferences for matching media and applications to a particular purpose. Their professional image is important, similar to the IT consultants. There was less reliance on voice and more use of text-based media: "Primarily I use SMS not voice. There's lots of situations where I can't talk." Another said: "I use SMS for work and personal." "It's a lot cheaper to text if you just want to know the answer to a question, and it doesn't drain your battery as much if you're on the road all day." One participant

contacts family and friends through email rather than voice: "My mum, we might email each other 7 or 8 times during the day. They're usually just one line comments." This often reflects time pressures. A participant described choosing between email and texting (SMS) depending on whether an instant answer is needed: "If a considerable amount of information is involved, I'll actually ring them. It's very easy to send an email, if I know that person's going to be accessible to an email straight away then I'll send an email.. otherwise text message." Another said: "If they've contacted me by one means then usually I'll respond by that means."

These were thoughtful and discriminating users, sensitive to the strengths and weaknesses of their chosen technologies. One participant took a long time to choose her new phone. She needed a flip phone (to prevent accidental calls), good scheduler, predictive text and able to synch with her PC. A camera was not a necessity but "I have used it now I have got it". Compared to the IT consultants, there was less focus on the shortcomings/limitations of particular technologies. "I use the phone for voice and for connecting the PDA when it's out of a wireless area. For anything else I find the display too small, and with all the things it does you're always struggling. I prefer the PDA but the PDA is too big to carry normally, so I prefer to have the two separated. If I'm going out at night I want something smaller, out of the way, not bulky to use or carry around." Another stated that his mobile phone: " It's got everything on it that I use. If there were more things on it, it would probably take up more of my time. I'd try and use them, or want to see what they did. Sometimes there's too much options on phones." The participants rejected technologies that did not meet their needs: "I used to have a digital organizer. Typing things in was really annoying." Another participant had both a PDA and mobile stolen, she replaced the phone but not the PDA.

They were accepting of change: "As things advance, you're always changing and learning. Society changes and you have to," and "Everything moves on. New technology comes out." Several participants embrace new technology, happy to experiment with new things: "I bought an iRiver.. I actually thought I didn't need one but now I've got it I love it. If I see something I really like, I always – if I can afford it – go and get it… If it doesn't work out I'll sell it on eBay." After discussions at one of the focus groups: "hearing the others talking about iRiver, it's the feedback from other people and how other people use it [that is] more trustworthy than information from the technology companies." A third said: "I'm attracted by technology that combines a lot of things, like the iRiver. Not by the size or how many songs it stores. Memory is important for work - can store things for work – but not for pleasure. I'm attracted to the design, how it feels, its function, color, size of the screen." He has rejected mono-functional devices: "I prefer to have a lot of things you can do with one device."

At the same time, some participants had concerns about the future. One said: "I'm a little bit concerned about becoming too dependent on mobile technologies. If I had everything of my organizational stuff, meetings, absolutely everything and I broke it, or forgot to charge it, or someone stole it, I'd be lost. Too much in one thing." This participant ensures that he is not reliant on only one device and that he can access important information through multiple means. Another participant reflected: "Technology is secondary in my life, well it is in my workplace. At the moment I would say that I drive the technology and I hope that I don't get to the situation that technology drives me. There's more to life than being attached to computers."

Discussion

"The key to grasping the dynamic possibilities of human agency is to view it as composed of variable and changing orientations within the flow of time" (Emirbayer and Mische 1998). Participants' temporal orientations when selecting technologies while mobile are shown in Figure 1, the framework derived from the inferential coding. The temporal dimensions of human agency proposed by Emirbayer and Mische (1998) form the foundation of Figure 1. The three major categories that relate participants' technology selections to these temporal dimensions stand on this foundation. The technology portfolio captures the habitual dimension, the devices, applications, media and other resources that have been trialed, assessed and added to the individual's resources that are accessible when mobile; multiple portfolios are shown, representing their provisional and changeable nature. Contingencies express the concerns of the present, the uncertainties that are experienced when mobile and the influences on technology selections: the individual's purpose, activities, people that one is interacting with (present or remote), the context (e.g. physical, spatial, social, technological) and the individual's preferences (e.g. for technology, interaction style, synchronicity). Imaginings represent the individual's projections of future possibilities, both positive and negative. A user's technology selections at the moment are informed by attention to the often-conflicting temporal orientations: the past (the technology portfolio and associated use practices) and the future (imaginings about possible technology and technology-related practices) while evaluating the practical challenges of the present

(emergent contingencies and influences on evaluating and acting on them). The three categories are discussed below in relation to Emirbayer and Mische's three temporal dimensions.

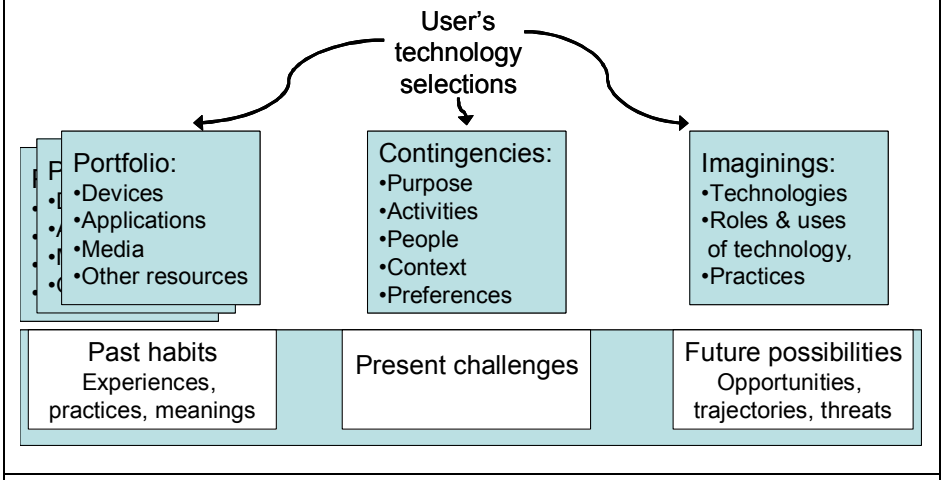

Figure 1. Temporal influences on a User's Technology Selections while Mobile

Looking to the Past

Over time, all three cohorts gathered diverse resources that they access while mobile. The metaphor of a technology portfolio captures participants' strategies to harness past experiences, evaluations and interpretations of technology. It reflects an overall perspective of integration not merely accumulation of resources. A portfolio approach in finance and investment aims to maximize benefits through an appropriate mixture of high-risk, high-return and low-risk, low-return investments. It is underpinned by diversification, where risk is spread over a number of options, and the investor concentrates on the overall performance of the portfolio. Applied to the selection of technologies while mobile, a technology portfolio is constructed to meet the needs of a particular user while mobile; contains a diverse mixture of resources, both electronic and non-electronic; takes a holistic approach, where individual components can be 'mixed and matched' to maximize the overall value gained from technologies while mobile; and is flexible so the contents of the portfolio can be updated and applied in different ways as the user's needs change.

The contents of a technology portfolio do not have a one-to-one match with identifiable tasks; rather the overall portfolio is employed in the undertakings that constitute everyday life, indicated by the intertwined multitude of activities (work, educational, social and personal) and purposes (communicating, managing information, organizing, providing affect and expressing identity) identified in the research. All participants were undertaking knowledge work, engaged in work/study activities that satisfied multiple purposes rather than tightly-bounded tasks.

A technology portfolio is built on the experiences of the past when technologies were trialed, and either rejected or added to available resources. Participants have constituted practices and workarounds to deal with this diversity of technology options and their individual strengths and weaknesses. Their actions illustrate how participants exercise their agency: they do not merely accept new technologies that are pushed onto them but intentionally appropriate a range of functions, features, media and devices that most closely meets their particular needs and preferences. The three cohorts built their portfolios in different ways, influenced by their circumstances (students/professionals); curiosity about new technology (IT postgraduates and young professionals) and sensitivity to IT shortcomings (IT consultants); professionalism (IT consultants and young professionals); need for control over technology (postgraduates), information (IT consultants) and time (young professionals); and the place of technology in their everyday lives. Their experiences with technology, observations of peers and the constraints of their work/study/social or personal contexts have led to additions to their pool of available technologies. Participants are now exploiting the strengths of these technologies (March 1991) to add value to their lives.

The technology portfolio also looks to the possibilities of the future regarding inclusion of unfamiliar technologies that will either complement or replace existing technologies. For example, advances in entertainment technologies such as the iPod led some participants to add this technology to their portfolios. The iPod was then used for multiple purposes, replacing the single-function USB key for some purposes (storage of large files) but not others (easy

backup of smaller files while on the move). Thus, there is some redundancy in the technology portfolio, allowing for nuanced selections of appropriate technology components for specific purposes. While, in Emirbayer and Mische's terms, the past orientation is dominant, there is also some orientation to the future in speculating about the possibilities of new technologies, a willingness to experiment and trial unfamiliar technologies and to envision how technology might be in the future, as outlined in the next section.

Looking to the Future

Participants reflected on the strengths and weaknesses of their current technologies and looked to future innovations. The context of the research is a time of rapid technology change and unprecedented choice. This, matched with the technological facility of the participants—young people in a developed country who have grown up surrounded by computing artifacts, and IT consultants—explains observations that the participants were at ease with technology, unafraid to explore novel technologies in a marketplace that provides them with a smorgasbord of technological options. They were aware not only of the positive potential of technology innovations but also of possible negative outcomes from increased reliance and intrusion of technology in their lives. These imaginings reflect the future temporal dimension outlined by Emirbayer and Mische (1998) and were expressed in somewhat different ways.

The postgraduates were curious about technology, unafraid to experiment and able to articulate their desires for future technologies including preferences for a converged device that met their needs. Like the post-graduate cohort, the IT consultants articulated a desire for a converged device for practical reasons: they wished to reduce the load of technologies currently carried. At the same time, they are very much aware of size constraints on any converged device. Although both these cohorts expressed their desire for a converged device, their actions in using mobile technologies indicate that 'best of breed' devices that provide optimal performance for specific purposes (e.g. a digital camera) are preferred for some activities whereas a converging device that involves a compromise on performance is acceptable at other times. This gap reflects the difference between espoused theory ('I want a converged device') and theory in action ('I use multiple devices that best meet my needs') (Argyris and Schon 1996). The participants look to a future where the complexity of mastering, carrying and managing many devices is replaced by the simplicity and convenience of fewer, converged technologies. The participants' actions, in persisting with multiple technologies, reflect their preference for deriving value (usefulness, pleasure, symbolism) from specialized technologies. This reflects the difficulty of designing converged devices to support "the huge variability in what people do, their motives for doing it, when they do it and how" (Rogers 2006:405).

In contrast, the young professionals had fewer concerns about particular technologies that they used but more generalized concerns about technology and its likely future roles in their lives. Reservations about the potential for dependence on technology, about risks in case of technology failure and about loss of control were articulated. On the other hand, these participants were accepting of change, they welcomed the possibilities for new technologies, new ways of doing things and had a willingness to experiment with innovations.

Dealing with the Present

Mobility involves uncertainty and ad hoc activity (Carroll et al. 2001; Perry et al. 2001). At any time, a person on the move may face a host of contingencies. Having constructed personal technology portfolios from myriad available technologies, both mobile and fixed, participants then thoughtfully combine, adapt and apply selections from these portfolios to deal with contingencies. This may involve simultaneous use of multiple media, seen when a young professional resolves a problem detailed in an email through a mobile phone conversation, or the young woman who has two mobile phones in use at once. Influences on selections include their purposes, activities, contexts of use, personal preferences (e.g. for convenience or asynchronous communication) and sensitivity to others' preferences. Emirbayer and Mische (1998:967) build on pragmatist thought and argue that human action cannot simply be reduced to the pursuit of pre-established ends. Rather, they emphasize the exercise of human agency in dealing with conflicting temporal dimensions and unfolding contexts over time. Thus participants did not merely reproduce past practices or technology selections. At any given moment, individual users select technology from those 'to hand' in their technology portfolios in response to their temporal orientation, the challenges of their immediate context as well as their particular preferences and motivations. They may chose to draw on past experiences or try to imagine and pursue some alternative possible trajectory of action as they deal with their present demands.

The ongoing juggling between conflicting temporal orientations suggests that users' portfolios are able to be continually changed, although the possibility of continual change is rarely enacted by users (Howard-Grenville 2005). All cohorts spoke of losing technologies (through forgetfulness or theft) and chose whether to replace them with care. All were keen consumers of technology and so were willing to buy and trial new technologies; those that were unsatisfactory were sold on eBay, passed on to friends or family or just discarded. Changes to a portfolio occur irregularly as new technologies become available, new routines and workarounds are constructed and new possibilities are communicated to users. Such evolutionary change enables people to shed outmoded technologies and embrace emerging technologies, some of which will be valuable in the future (Brown and Eisenhardt 1998). The important role of communication in diffusion of innovation (whether technologies or practices) has long been recognized (Rogers 1995). The primary use of mobile technologies identified in these three cohorts is communication. The effortless and speedy communication of encounters with new technologies enables technology selection and use practices to be produced and reproduced across user cohorts in different contexts; this moderates the uncertain and remote returns from exploration noted by March (1991) and encourages users to explore and evaluate technology options that become available. Thus, intense communication with other technology users leads to greater variety in use practices (Shih and Venkatesh 2004).

Participants' actions are set against a backdrop of uncertain user needs. Practices around mobility are still unformed: the introduction of mobile phones had profound effects on computing because they are personal technologies that are used for multiple purposes in multiple contexts. Their effects rippled onto use of fixed organizational technologies as users have combined resources to provide connection, communication and information as they move between locations. One of the effects of blurred boundaries between work and play, the organizational and personal, is that social and personal practices have leached into organizational practices, evident in descriptions of the IT consultants' and young professionals' practices. Further, ongoing technological innovation and changes in practices leads to new needs and new value derived from the creative application of technology in unexpected contexts for unforeseen activities.

Faced with such uncertainty, constructing a technology portfolio appears to be an effective strategy for managing the interplay of habit, imagination and judgment in dynamic contexts. Technologies are accessed from their portfolios contemporaneously, as users select and combine resources within brief time periods to deal with the contingencies of the moment: new needs, unexpected events or interactions with unknown technologies. This is evident from participants' careful and discriminating technology selections that provide tailored technological support. These selections may be one-off decisions to meet a present need and will frequently be reconsidered and renegotiated as technologies change, needs emerge and contexts change. This suggests that any stabilizations of practice will be temporary moments in an environment of change; this view is reinforced by Emirbayer and Mische who emphasize the potential for actions and contexts to be other than they are at present.

Implications

Re-thinking the IT Artifact

This paper set out to theorize the technology artifact for mobility. The ubiquity of mobile technologies, the vast array of mobile and fixed technologies available to people on the move and improved telecommunications networks provide people with options. The research findings suggest that people choose from these options in two ways. Firstly, they construct technology portfolios as an outcome of deliberate and reflective choices. The metaphor of a technology portfolio is used to indicate its purposive, diverse, holistic and provisional nature. The technology portfolio captures past experiences, trials and interpretations of technologies. Secondly, individual components of the portfolio are selected, mixed and matched by people on the move according to particular temporal orientations of the moment in order to enhance their lived experience. This ongoing process of multiple selection points of multiple technologies reflecting conflicting temporal orientations is a fundamental change from use of a singular technology in a given context to meet a predetermined need or goal.

There is a scarcity of research examining clusters, collections or portfolios of technology where the impact of existing technologies (available, accessible or included in a portfolio) influences the selection of new technologies and where synergies between technologies lead to unexpected outcomes. Rogers (1995) argues that examining innovations in a cluster separately leads to distortion and incomplete understanding of the processes of diffusion. This is supported by Shih and Venkatesh (2004) who found the presence of complementary technologies led to

increased variety of use of the computer, as does ownership of the 'latest' technology. Analytically separating key technologies or innovations in order to understand them more deeply may be a sensible starting strategy in a domain characterized by emergence, ad hoc activity, blurred boundaries and unfolding trends. However, these separate investigations need to be complemented by studies of the whole that include analysis of existing technologies, those technologies that are combined or accessed contemporaneously, and users' perceptions of synergies between these technologies. This paper has argued that people on the move build portfolios of technology that are thoughtfully constructed suites of technologies that reveal the importance of complementary technologies in their lives. How this is achieved and maintained is an intriguing question worthy of further research.

Re-thinking IS Models

To date there appears to have been little integration of findings from individual studies of mobility into mainstream IS thinking. Such integration may lead to re-consideration of some of our long-accepted theories, frameworks and models. This analysis examines three such models, as an indicator of potential critical evaluations. First, the findings indicate that one of the mainstays of technology acceptance research, perceived usefulness (Davis 1989), may need review. Perceptions of usefulness range beyond enhanced job performance to improved communication, organization of people's lives, affect and symbolic expressions of identity. Connection, contact and communication were of primary importance to the participants. Sociologists note that our post-modern world is marked by "serial, ephemeral, short-term, contingent relationships" (Pescosolido and Rubin 2000). There is an increased need to connect with others, to nurture ephemeral links and to construct cohesion from diverse, dispersed and often tenuous contacts. This is supported through the strength of personal attachment to technology observed in the young professionals and the concerns for the influence that future technologies may play in their lives. Investigation through descriptive research across more cohorts and larger samples is needed to examine the importance of these drivers of users' perceptions of usefulness. Second, a classical model for IS success (DeLone and McLean 1992) features 'information quality' and 'system quality' that lead to use and user satisfaction and thus individual and then organizational impact. Observations in this research indicate that 'information quality' needs to be supplemented at least by communication quality and organizing quality; where the media and applications that are selected and combined lead to perceptions of quality; where the relationship between individual and organizational impacts should be re-examined (as personal, social, leisure and educational activities seep into work life, and vice versa); and finally the concept of IS success itself may need to be re-conceptualized or at least re-expressed and operationalized in new ways. Third, the findings indicate that a focus on individual tasks is only one small part of the overall activity undertaken while mobile: the participants were managing their lives, not single tasks. This suggests analyzing task-technology relationships (Goodhue and Thompson 1995) is subsumed in the analysis of supporting and enhancing people's everyday experience. The findings also emphasize the importance of looking beyond an individual technology in this analysis to carefully examining the relationships between different technologies (devices, applications and the media) that in combination meet mobile users' needs.

Re-thinking IS Research Strategies

The accounts of the participants' technology selections and use are strikingly different to technology accounts in much of the extant IS literature. The findings of this research show, often in the participants' own words, the range of technologies employed by people on the move and how they are brought together to augment their everyday activities. However, there is very little mention or analysis of this trend in the IS literature. Periodic debates about the relevance of IS research exacerbate concerns as to why this important change in users' technology-related practices is not receiving more attention in the leading IS journals. This has been an intensive study that notes similar patterns of technology selections and uses by three diverse but technologically-aware cohorts but the findings are not unusual; similar trends have been reported in the press, can be readily observed in organizational contexts and described in studies of people on the move (e.g. Sorensen and Pica 2005).

Why has the concept of a singular IT artifact not been updated? The findings of this research arose from immersion in real-world situations, through analyzing observations and refining the research focus in response to those observations. They were not driven by research questions derived in isolation from practice. Donald Schon (1983:42-43) contrasted the 'problems of the high ground' where rigor abounds but the problems are relatively unimportant (to clients and to society) with the 'swampy lowlands' that are the home of "messy but crucially important problems". It appears that the 'swampy lowlands' inhabited by people on the move have been overlooked in much current IS research. One way of ensuring relevance for IS is to undertake exploratory studies in the field, to

thoroughly interrogate surprising outcomes and thus to identify trends that are not explained by existing IS theories, models or frameworks, This opens up new areas of investigation that are relevant to real-world practice, to organizations and to society.

Conclusion

Orlikowski and Iacono (2001:121) argue that the IS field has not engaged deeply with its primary object of interest, the IT artifact. This paper has addressed this criticism and engaged with technology in one domain, mobility. It has examined the ways that technology innovations that enable mobility have led to profound changes in the way that people select and use technology. Consequently it suggests that we need to re-think some of our concepts and theories. It contributes to IS research in four key ways.

The paper argues that the singular 'IT artifact' that is evident in much IS research has little relevance for mobility. The findings of field studies of three quite different user cohorts are used as a resource to explore the implications of peoples' actions in constituting portfolios of technology that are accessible while mobile. Individual users, faced with uncertainties, ambiguities and various contingencies in the moment will select, combine and adapt from these portfolios to meet their present needs. Thus, multiple technologies should be the unit of analysis for some IS research and so provide a new perspective, and additional complexity, to the concept of the technology artifact. Further investigation is needed into how portfolios are constructed and reviewed over time, the role of existing technologies (both competing and complementary) in the selection of new technologies, whether perceived synergies between new and existing technologies are valued and users' views on redundancy between functions, features, media and applications. Additional work is also needed into the role of these technologies in communicating new practices and evaluations of new technologies to other users. To date we know little about how and why technologies are selected, combined, adapted and applied by people on the move. Shifting our focus from a singular IT artifact to multiple, complementary technologies is an important start to addressing this lack of knowledge.

The findings lead us to re-think the concepts and theories that we apply to the interaction between people and technologies. Some indications of how well-tested models devised for stationary organizational contexts may need to be enhanced for our technology-rich, mobile society have been supplied in relation to TAM (Davis 1989), the IS success model (DeLone and Mclean 1992) and the Task-Technology Fit model (Goodhue and Thompson 1995).

The findings highlight the need to initiate research in the 'swamp' of real-world practice, to explore contemporary practices and issues of importance to individual users, organizations and society to complement existing approaches. The paper argues that this is one way to increase the relevance of our discipline.

Finally, this work adds to a recent stream of IS publications that applies the temporal perspective of Emirbayer and Miche (1998). This perspective was valuable for explaining the nature of technology selection and use in the uncertain and ambiguous circumstances of mobility. The paper contributes to work that opens up this alternative agentic lens and Figure 1 is one example of the way that this perspective can be operationalized for IS research.

The particular area examined in this paper is technologies accessed by people on the move. However, some of the analytic concepts raised in the discussion may be applied beyond mobility. The findings add to research that extends the issues that are covered in IS: from information to communication, organization, affect and personal needs. Technology is viewed as enhancing everyday life in multiple ways, by providing assorted services that cross work, education, entertainment, personal and social boundaries. It is present with people as they negotiate their lives, shifting attention from education, to work, family and friends, navigating interactions with institutions, while connected through a web of people and technologies to other individuals, groups, organizations and societies in the larger world. People work to overcome the fragmentation of post-modern society (Pescosolido and Rubin 2000) and to re-connect with others using technology rather than public spaces or physical proximity. The glimpses of these participants' lives provide powerful insights into future practices: they reveal what is to come, not just for technologically-aware knowledge workers but more general trends in other domains than mobility. Developments in technology and use practices in the previous ten years challenge the singular view of the IT artifact and indicate a broader view of the nature of 'the technology'. Investigating this multiplicity has exciting potential to produce relevant IS research.

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